BaudMaster™

BMFBR
Fiber Optic Converter

User's Manual

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Innovative I/O Since 1977

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BaudMaster™

BMFBR
Serial Data Optical Interface Converter
User's Manual

5 Year Warranty

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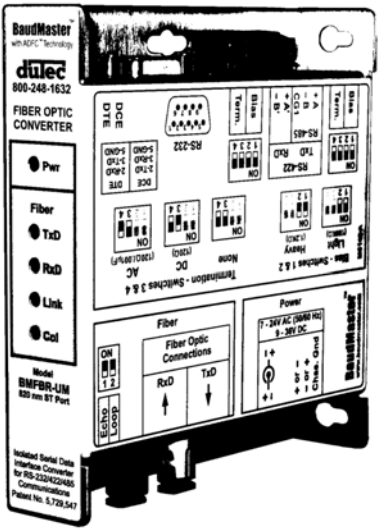

Introduction

RS-232, R-S485, and RS-422 are among the most successful and widely used computerized serial interface standards for industrial applications. There are sometimes applications where digital electronic signals are available, but it is desirable to use an optical interface. These circumstances could be to prevent interference with communications in high noise environments, to provide electrical isolation, or to prevent interference from other electrical communications signals. In order to convert electrical signals to optical signals, a special converter is required. The BaudMaster™ family of interface converters are designed to easily convert data from any of these electrical serial interface standards to light signals on fiber optic cables. The BaudMaster™ automatically controls the direction of serial data on the electrical interface, eliminating the need for software flow control. Using a patented technique (Automatic Data Flow Control, ADFC™), BaudMaster™ interface converters automatically adapt to any baud rate up to 115K baud and is independent of communications protocol. The BaudMaster™ can be used in your industrial applications without any hardware of software changes.

Features

- ADFC™ (Automatic Data Flow Control), uses a technique protected by US patent #5,729,547 that automatically senses and controls the direction of RS-485 data eliminating the need for software control.
- 3-in-1 signal conversion converts RS-232 or RS-422 or RS-485 to fiber optic signals. This conversion automatically senses RS-422 four wire operation.
- Status LEDs are provided for power, transmit data, receive data, optical collision and link detect signals. These are handy for verifying operation and troubleshooting network problems.
- Transient voltage protection, all electrical signal and power inputs are protected against high voltages.
- Baud rate independent, no switches or jumpers to set. Automatically adapts to all standard and non-standard baud rates up to 115Kbaud.
- Versatile power supply, The unit can be powered by a wide range of AC or DC voltages. Wall plug adapters are available from duTec or others. A pluggable screw terminal is also provided for use with other power supplies. 7 to 24 volts AC or 9 to 36 volts DC @ 155 mA max.
- Pluggable terminal blocks, industrial rated terminal blocks for ease of installation or removal. Accepts up to 16 AWG wire.
- Standard 820 nm operation uses standard ST connectors and readily available 50/125 or 62.5/125, 100/140, or 200 um HSC multimode fiber.
- 650 nm plastic fiber version for popular lower cost plastic fiber, over shorter distances.
- DIN rail mounting accessories available for quick and easy mounting.

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Specifications

Isolation	Electromagnetic: Power-to-RS-232/422/485, Power-to-Chassis, RS-232/422/485-to-Chassis. Hi-Pot: 1500V_{RMS} for 1minute, xxxx VDC for 1 second Leakage Current: Less than xxxuA @ 1500VAC / 60Hz; xxxx VDC
Baud Rate	0 to 115Kbps
Range	RS-422 and RS-485 4000 Ft (1.23kM) @ 38.4Kbps using 24AWG twisted pair Optical - Up to 1.2 Miles (2kM)
Weight	13.5 oz. (383 Grams)
Power	7 to 24 Volts AC / 9 to 36 Volts DC @ 155mA (max) 9 VDC @ 155 mA (max) 12 VDC @ 110 mA (max) 24 VDC @ 60 mA (max) 36 VDC @ 40 mA (max)
Enclosure	18 Gage Stainless Steel Type 304
Dimensions	Height: 4.6 Inches (117mm) Depth: 4.16 Inches (106mm) Width: 1.00 Inch (25mm)
RS-485/422	Supports RS-422, 2 or 4 wire, RS-485 Autodetect Input resistance: 12KΩ to 15KΩ (single unit load) Biasing Resistors: Selectable, 1.2KΩ or 100KΩ Termination Resistors: Selectable, None, AC (.001µF in series with 120Ω), DC (120Ω)
RS-485 Enable	Automatic, Patented ADFC™ technology automatically controls data flow direction
RS-232	Supports TxD, RxD, DTR, DSR, RTS, CTS, DCD Connector: DB9 male or female DCE or DTE selectable Short circuit protected Input resistance: 3KΩ to 7KΩ ESD tolerance > +/-15kV
Optical Transmitter	820 nm LED, Type ST connector, IEC AEL class 1, Output Power -22.2 to -6.9 dBm (min.) depending on model and fiber type. 650 nm LED, Type ST or SMA connector, IEC AEL class 1, Output Power -7.5 dBm (POF), -18.0 dBm (HCS)
Optical Receiver	820 nm, Type ST connector, -24 dBm minimum input 650 nm, Type ST or SMA connector, -21.6 dBm (POF), -23dBm (HCS)
Operating Temperature	-25°C to +80°C
Storage Temperature	-45°C to +100°C
Humidity	5% to 95% RH
Compliance	RoHS Compliant Pending: CE, FCC Class A, CUL, UL safety Class II
Accessories	Din Rail Mounting Kit P/N DA-01 AC Power Adapter: North American 120V input P/N BM-PS120 AC Power Adapter: European Universal input 90 to 264 VAC P/N BM-PSU
Surge Protection	600 Watt transient voltage suppression on all RS-232/485/422 and power lines
Indicators	Power, RxD, TxD, Link and Collision LEDs

Switch selectable options

Termination and bias resistors, equipment termination and bias can easily be configured with DIP switches accessible from the outside of the converter case. The switches are clearly identified on the label for easy setup.

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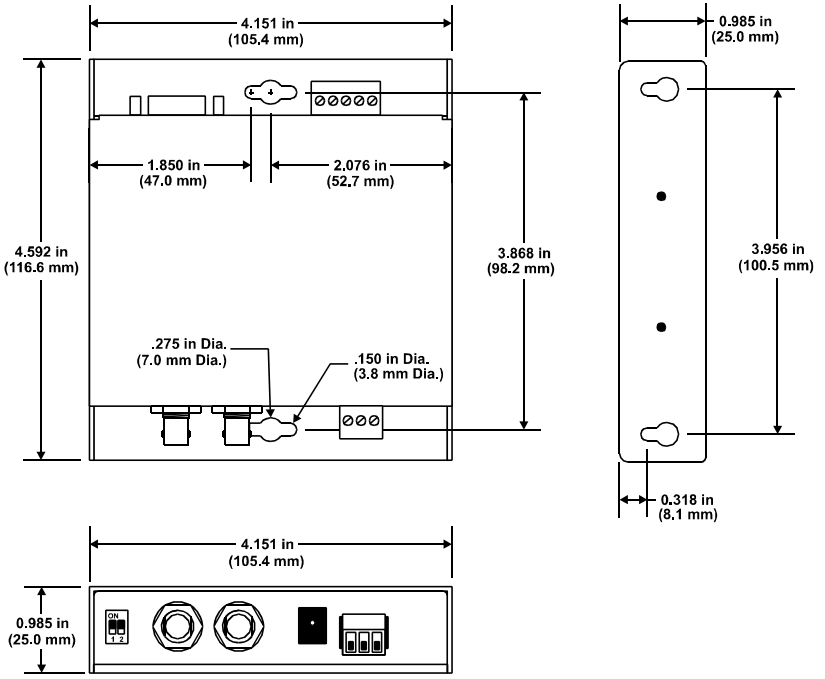
DTE-DCE Selection, a switch easily makes the BaudMaster™ either a DTE or a DCE device so the unit will communicate with a DCE or DTE device, or operate with a straight through or null modem cable.

Echo, with the echo feature enabled, equipment side transmit data is echoed back to the equipment side receive port. This may be desirable or required with some protocols. The default is no echo.

Ring, with the ring feature enabled, received optical data is re-transmitted for ring topology networks. The default is no re-transmit.

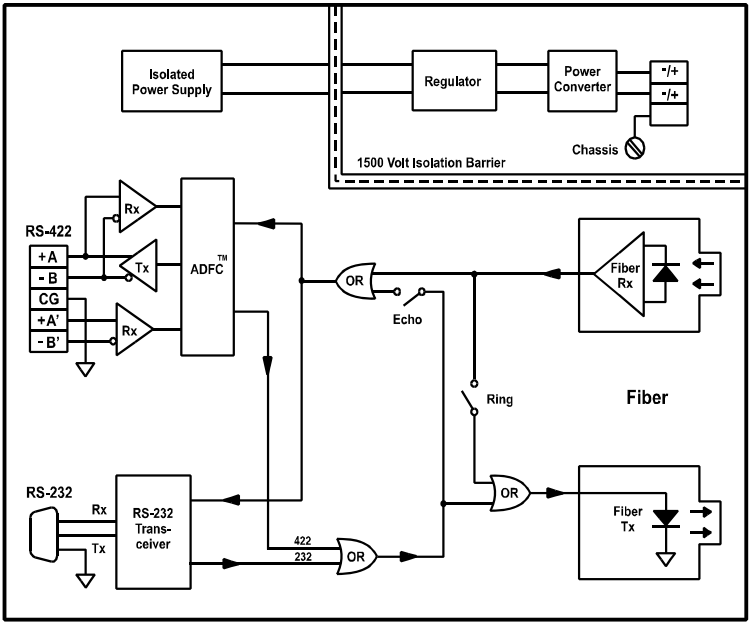
Dimensions



Description

The BaudMaster™ BMFBR-U*xx* is our most versatile interface converter. It will convert RS-232 to Fiber, RS-422 to Fiber, or RS-485 to Fiber. The diagram below shows the function blocks, and signal paths.

Block Diagram



Either RS-232 or RS-422/485 signals are converted to optical signals and vise-versa. Full galvanic isolation between the power supply and the RS-232, RS-485 and RS-422 ports eliminates all grounding and surge problems up to 1500 volts.

The ADFC™ (Automatic Data Flow Control) function block controls the flow of RS-485 serial data. ADFC™ technology uses a technique that constantly monitors data and automatically senses and controls the direction of RS-485 data eliminating the need for software control. Other techniques control the flow of data with a precision timer that must be configured for the correct baud rate or only enables the transmitter on a "one" bit and relies on the biasing resistors to maintain the correct voltage for a "zero" bit. ADFC™ is superior to both of these methods in that the transmitter is enabled for the entire transmission and is independent of baud rate.

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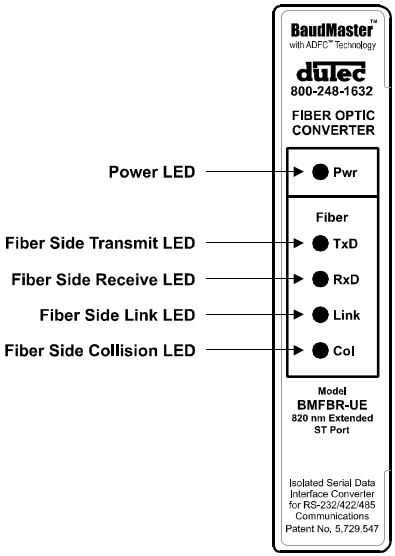
LED Indicators

All models of the BaudMaster™ BMFBR have five status LED indicators. These indicators show the status of data communications and power and are handy for verifying operation and troubleshooting network problems.



LED Name	LED Function
Power	Red indicates the power is on
TxD	Transmit - Red indicates that the RS-232/422/485 port is sending data to the fiber port
RxD	Receive - Red indicates that the fiber port is sending data to the RS-232/422/485 port
Link	Link - Red indicates that a carrier signal is detected and the fiber receive (RxD) connection is good
Col	Collision - Red indicates that an attempt to transmit while receiving optical data in ring configuration

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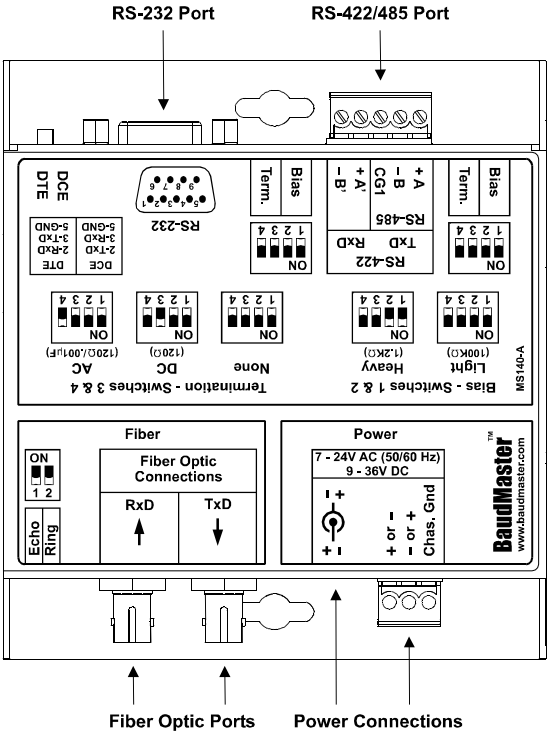
Serial Ports

The BaudMaster™ BMFBR can have both an RS-232 and an RS-422/485 port, depending on the model. All models have optical transmit and receive ports. The optical ports have either an ST (bayonet) or an SMA (threaded) connector. Two power connectors are available for either a P5 plug or hook-up wire.



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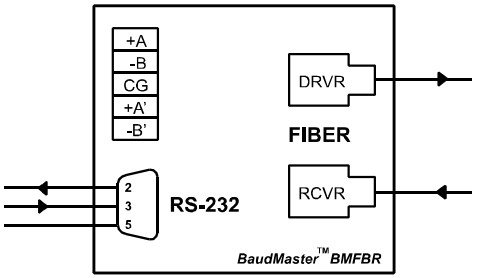
Typical Applications

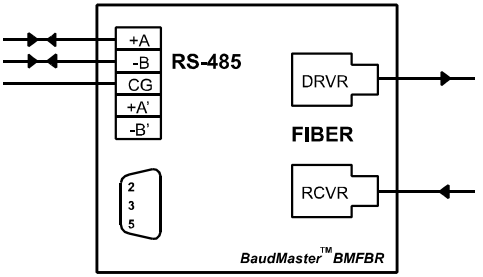
The BaudMaster™ BMFBR can be used as an asynchronous serial signal converter, isolator, extender or repeater.

Converter

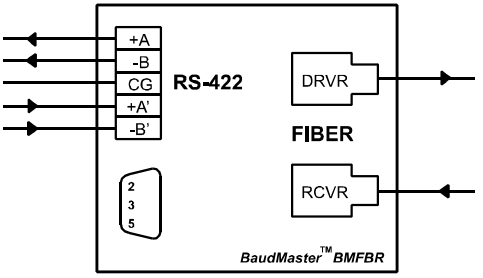
RS-232 to Fiber Converter



RS-485 to Fiber Converter



RS-422 to Fiber Converter



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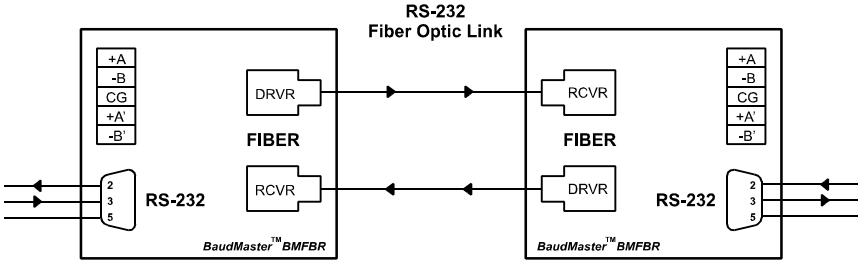
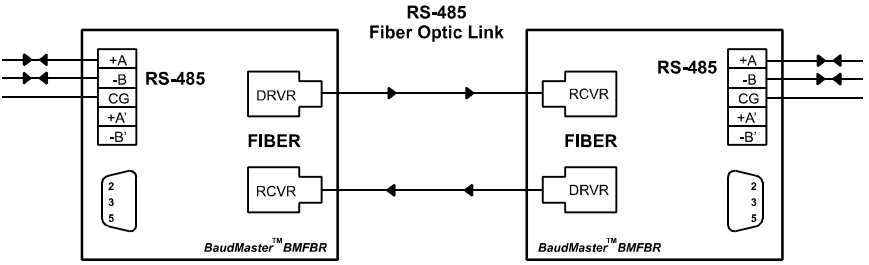
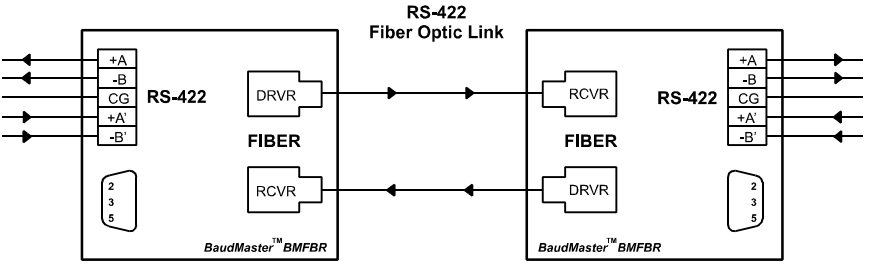
Isolator and Extender

The BMFBR can isolate and extend an RS-232, RS-485 or RS-422 link.







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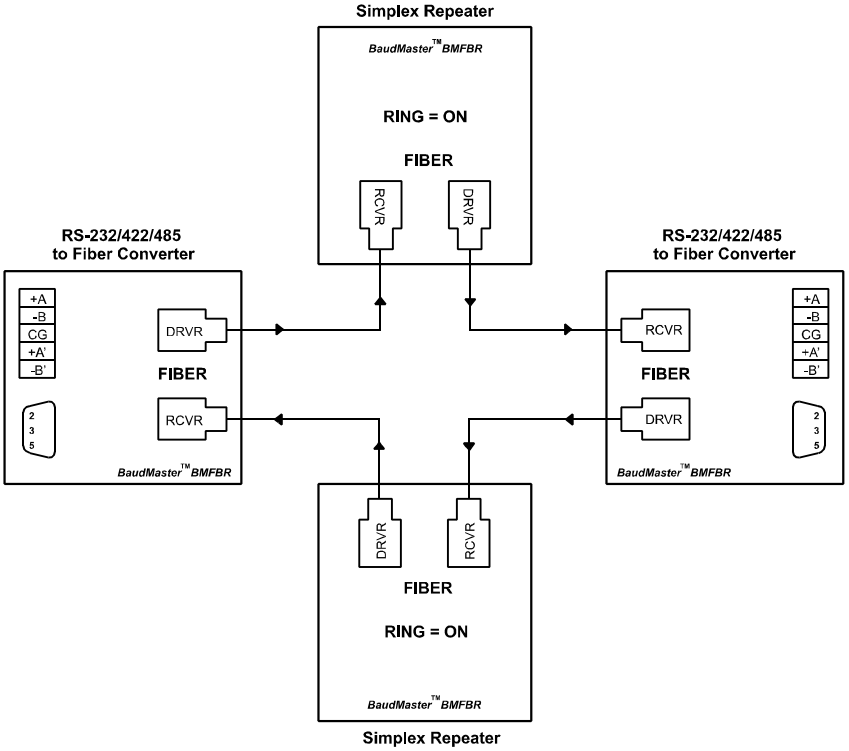
Repeater

In Ring Mode the BMFBR can operate as a Repeater to extend the distance of an optical link. Two are required for full or half duplex communications. In Repeat mode the BMFBR will support data rates up to 2 Mbaud.



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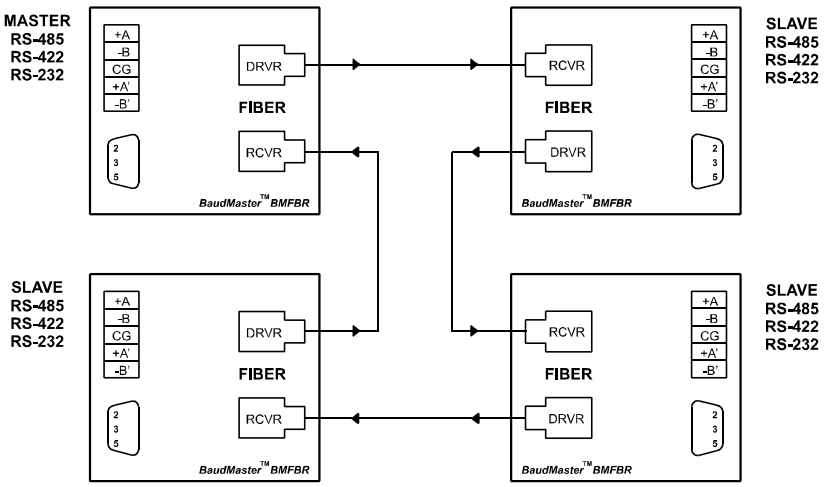
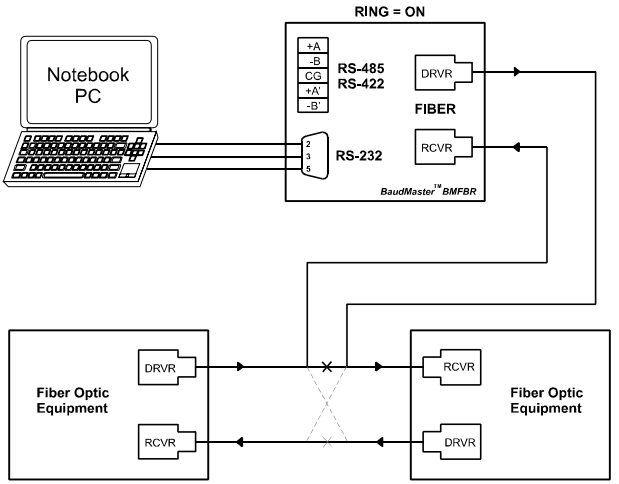
Multi-drop Fiber Optic Ring Network



Optical Communications Troubleshooting Tool



Configure Baudmaster as a repeater and insert into either transmit or receive fiber path to monitor data on a fiber link with an RS-232, RS-485, or an RS-422 device.

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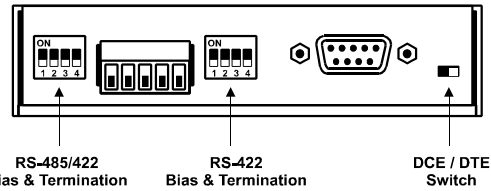
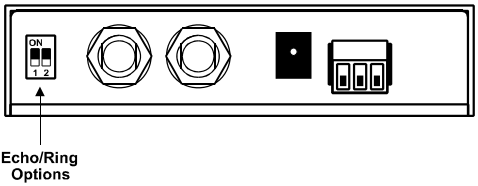
Configuration

The BaudMaster™ can be configured to accommodate various networks, cabling, and protocols. This section describes how to set up the RS-485/422, RS-232 and fiber options.





DCE / DTE

The RS-232 port can be configured as a DTE (Data Terminal Equipment) or DCE (Data Communications Equipment) device. A DTE device is usually a PC or terminal and has a male connector. The DCE device is usually a remote device such as a modem and has a female connector. For more information see the RS-232 section of this manual.

Echo Mode

Echo mode passes equipment transmit data to both the fiber optic transmitter and to the equipment receiver. Therefore the data transmitted to the equipment side (RS-232 or RS-485) is returned. This may be required for some software protocols. With echo off, the receiver is disabled when the transmitter is enabled and the data is not returned. Note: Do not enable echo in RS-422 full duplex networks.

Ring Mode

Ring mode re-transmits received fiber optic data on the fiber optic transmitter in addition to passing it to the equipment receiver. This configuration is used at secondary connections on "Ring" networks. It is also used when the BaudMaster™ is used as a fiber optic repeater.

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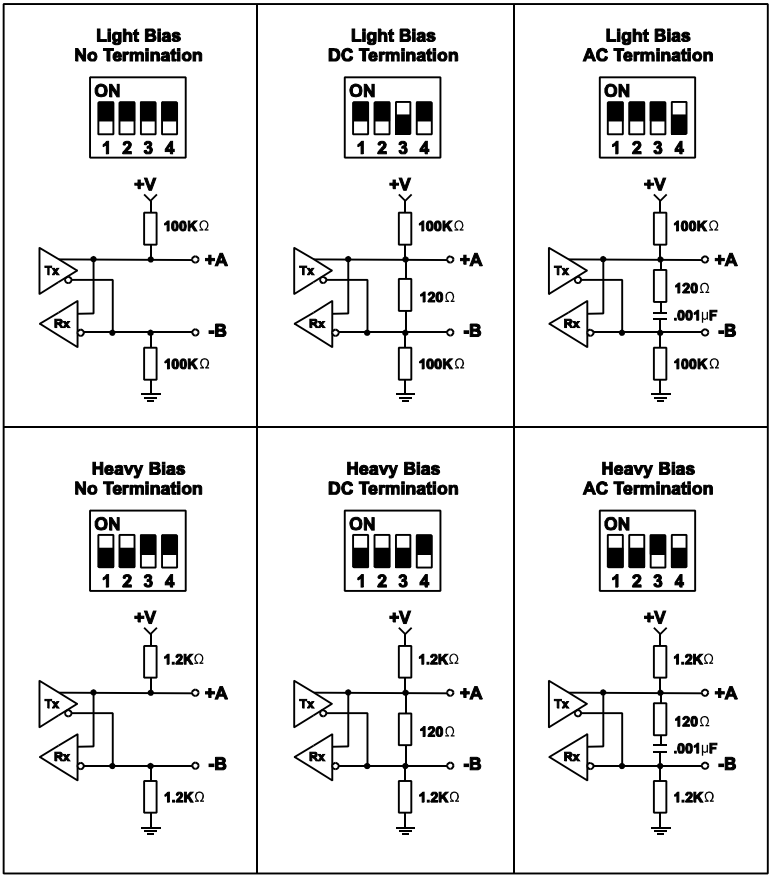
RS-485/422 Termination

The BaudMaster™ provides several options for terminating an RS-485 or RS-422 bus. The decision of what kind of termination to use depends on data rate, cable length, and other nodes on the bus. Bias and terminating resistors are used to maintain the proper idle voltage state and to prevent transmission line reflections. The kind of termination is selected with the DIP switches.

RS-485 Transceiver Termination



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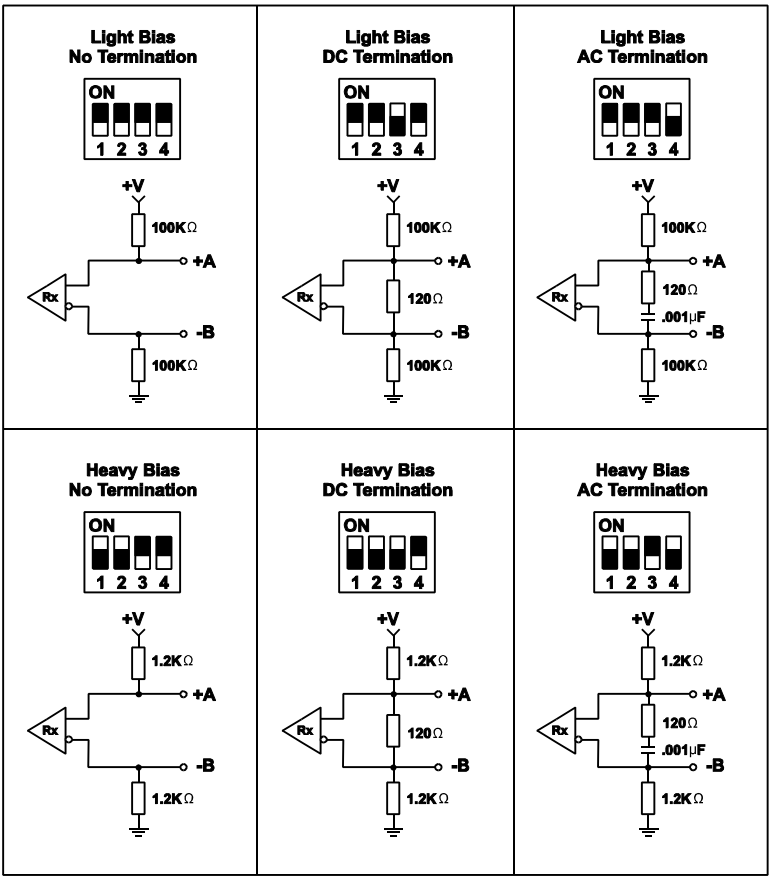
RS-422 Receiver Termination



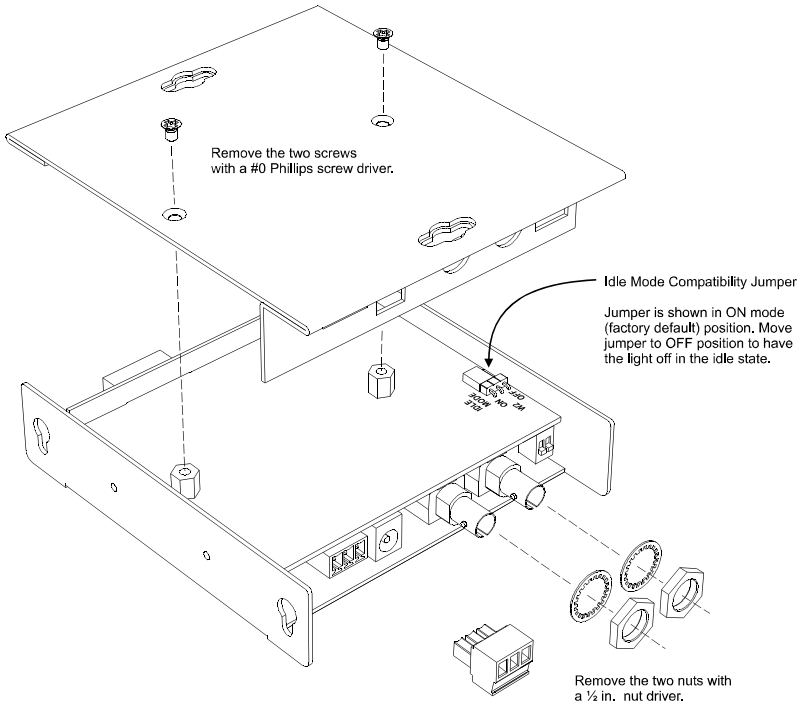
Note: If you are adding the BaudMaster™ BMFBR to an existing RS-485/422 network and are not sure how the existing devices on the network are terminated, select either *Light Bias, No Termination* or *Light Bias, AC Termination*.

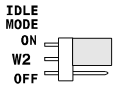
Optical Idle State

The factory default for the LED transmitter is to have the light ON in the idle state. To connect with fiber devices from other manufacturers that have the light OFF in the idle state, the internal Idle State jumper must be moved to the OFF position.

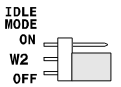
The unit must be partially disassembled in order to change the jumper position. Remove the panel nuts, washers, screws and pluggable terminal block as shown below. Separate the bottom cover from the rest of the unit to expose the W2 jumper. Reassemble and test.

Note: the Link LED will not function in the OFF mode. It will always be off.


Remove the two screws
with a #0 Phillips screw driver.
Idle Mode Compatibility Jumper
Jumper is shown in ON mode
(factory default) position. Move
jumper to OFF position to have
the light off in the idle state.
Remove the two nuts with
a ½ in. nut driver.



LED is 'ON'
in the idle state



LED is 'OFF'
in the idle state

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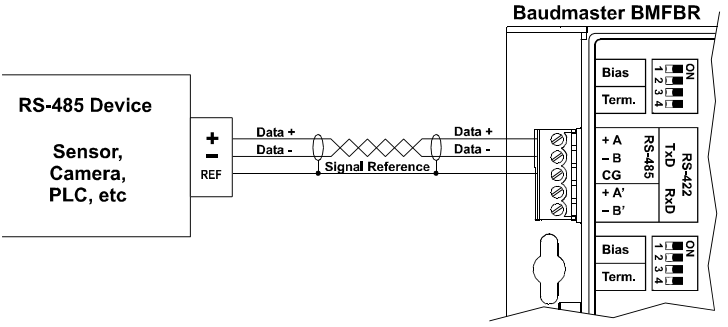
Connections

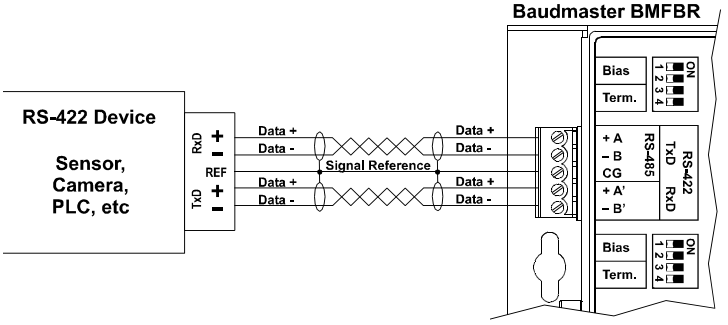
RS-485 wiring

When wiring to an RS-485 device, you will need to connect three wires to the BaudMaster™ terminal block. The best cable to use is twisted pair with a drain wire, such as Belden 9841. Connect + to +A and - to -B. The third wire is the signal reference and is required for reliable operation. Use the drain wire to connect REF to CG. If the device does not have a reference or ground terminal, it may be using the chassis as reference. If this is the case then connect the drain wire to it's chassis. If it is not, then there is no choice but to leave the CG terminal unconnected. Please refer to the section of this manual describing cable selection.



RS-422 wiring

When wiring to an RS-422 device, you will need to connect five wires to the BaudMaster™ terminal block. The best cable to use is two twisted pair with a drain wire, such as Belden 9842. Connect the first pair + to +A and - to -B. Connect the second pair + to -A' and - to -B'. The fifth wire is the signal reference and is required for reliable operation. Use the drain wire to connect REF to CG. If the device does not have a reference or ground terminal, it may be using the chassis as reference. If this is the case then connect the drain wire to it's chassis. If it is not, then there is no choice but to leave the CG terminal unconnected. Please refer to the section of this manual describing cable selection.



RS-232 Connection

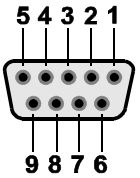
The RS-232 connection uses a standard female 9 pin D-Sub connector.

RS-232 Pinout

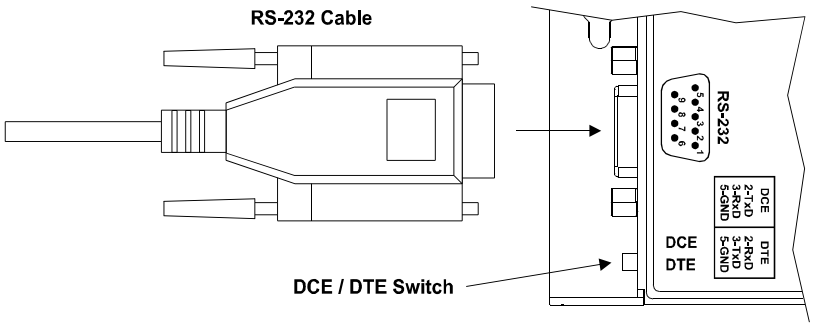
Pin #	Set for DCE	Set for DTE	Note
1	DCD	DCD	Pulled high with 4.7K resistor
2	TxD	RxD	Transmit/ Receive
3	RxD	TxD	Receive/ Transmit
4	DSR	DTR	Connected to pin 6
5	Circuit Ground	Circuit Ground	Signal Reference
6	DTR	DSR	Connected to pin 4
7	CTS	RTS	Connected to pin 8
8	RTS	CTS	Connected to pin 7
9	NC	NC	No Connection

Pins 1, 4, 6, 7 and 8 are connected to the correct levels to allow the device connected to operate under most conditions without additional loopback connections.

The DCE-DTE switch provides a convenient way to configure the BaudMaster™ as a DCE or DTE device. This allows the use of a "straight through" or "null modem" RS-232 cable. Units shipped from the factory are set for DCE operation.



DB9 Female



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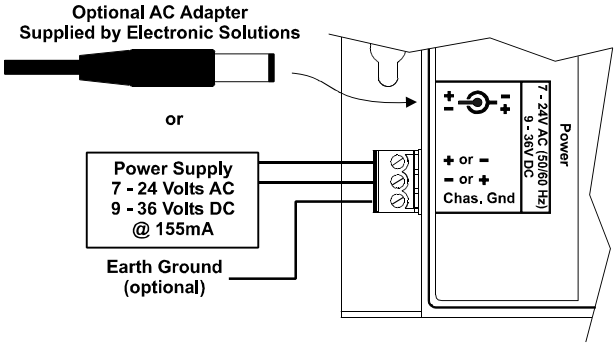
Power supply wiring

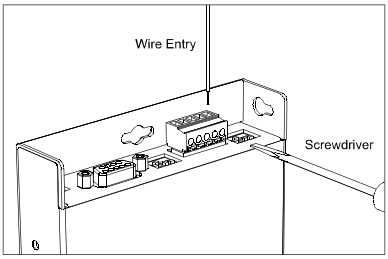
The BaudMaster™ incorporates special power converter circuitry that allows it to be powered by a wide range of AC or DC power. The maximum current draw is 155 mA. Power can be supplied to the unit with an AC adapter available from duTec. The unit can also be powered by any power source that meets the specifications as shown below.

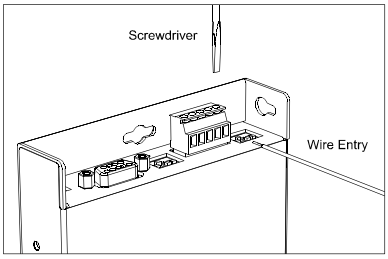


The earth ground terminal is connected to the stainless steel chassis and is provided as a convenient way to secure the chassis to earth ground. This may be desirable or required for certain applications.

Termination plugs

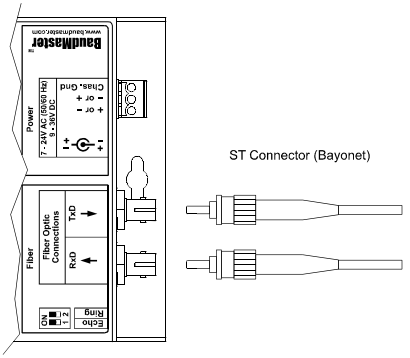
Termination plugs are available in two styles. The parallel style allows the wire to enter the terminals parallel to the unit. This is standard and probably preferable in most cases. The vertical style allows the wire to enter the terminals perpendicular to the unit. Termination style is specified in the BaudMaster™ order number. See the ordering information section of this manual.

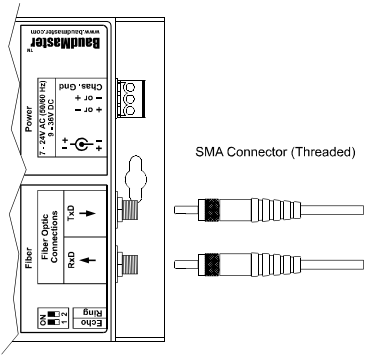




Fiber Optic Interface

The standard versions of the BaudMaster™ use type ST connectors and are compatible with 50/125, 62.5/125, 100/140 and 200um HCS multimode fiber cable. This flexibility means that the choice of fiber cable may be based on link distance, cost, compatibility with an existing fiber network, or ease of termination. The plastic fiber versions are available with either ST or SMA type connectors.





The maximum link distance is determined by the transmitter output, fiber losses, distortion, data rate, and receiver sensitivity. The BaudMaster™ product line offers three fiber interface versions, the standard (option M) and an extended distance transmitter with twice the output power (option E), and a plastic fiber version for short distances (Option T or A).

The fiber end and ferrule must be clean before it is inserted into the transmitter or receiver connectors. Dust, lint, oil, or other foreign material obscure the end face corrupting the optical signal being sent over the fiber. Fiber optic connectors and fiber ends should be cleaned every time they are mated. It is also important to keep the covers on both the fiber optic connectors of the transmitter and receiver, and on the fiber ends when they are not in use.

For asynchronous data at rates up to 2 Mbaud, expected worst case maximum link distance vs fiber type follows. These distances are based on a continuous fiber (No Splices), worst case transmitter, worst case receiver sensitivity and worst case fiber attenuation.

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Optical Link Performance Data

820 nm Standard Power (Option M)
Temperature = +25 degrees C unless otherwise noted

Fiber Cable (Multimode)	Typical Output Power (dBm)	Minimum Receiver Sensitivity (dBm)	Maximum Link Distance (Worst Case)		Maximum Link Distance (Typical)	
			Kilometers	Miles	Kilometers	Miles
50/125 µm	-18.2	-25.4	.300	.190	1.50	0.93
62.5/125 µm	-15.4		1.00	.620	2.50	1.55
100/140 µm	-11.4		1.45	.900	3.33	2.07
200 µm HCS	-5.9		1.35	.840	2.75	1.71

820 nm High Power (Option E)
Temperature = +25 degrees C unless otherwise noted

Fiber Cable (Multimode)	Typical Output Power (dBm)	Minimum Receiver Sensitivity (dBm)	Maximum Link Distance (Worst Case)		Maximum Link Distance (Typical)	
			Kilometers	Miles	Kilometers	Miles
50/125 µm	-15.2	-25.4	1.05	0.65	2.75	1.60
62.5/125 µm	-11.4		2.00	1.24	3.93	2.44
100/140 µm	-7.9		2.09	1.30	4.39	2.73
200 µm HCS	-3.9		1.55	0.96	3.08	1.92

Notes:
1. Link distances are based on continuous fiber, no splices
2. Output power measured at the end of 1 meter of optical fiber with large area detector.
3. Input sensitivity measured at the end of the fiber optic cable with large area detector.
4. Includes a 3dB optical safety margin to account for aging.

650 nm (Option A and T)
Temperature = 0 to +70 degrees C unless otherwise noted

Fiber Cable (Multimode)	Minimum Output Power (dBm)	Minimum Receiver Sensitivity (dBm)	Maximum Link Distance (Worst Case)	
			Meters	Feet
200 µm HCS	-18.0	-23.0	200	656
1mm POF	–7.5	-21.6	48	158

Notes:
1. Link distances are based on continuous fiber, no splices
2. Output power measured at the end of 0.5 meters of optical fiber with large area detector.
3. Input sensitivity measured at the end of the fiber optic cable with large area detector.
4. 1mm POF 0.23dB/m worst case attenuation.
5. HCS 10dB/km worst case attenuation.
6. Includes a 3dB optical safety margin for POF.
7. Includes a 2dB optical safety margin for HCS.

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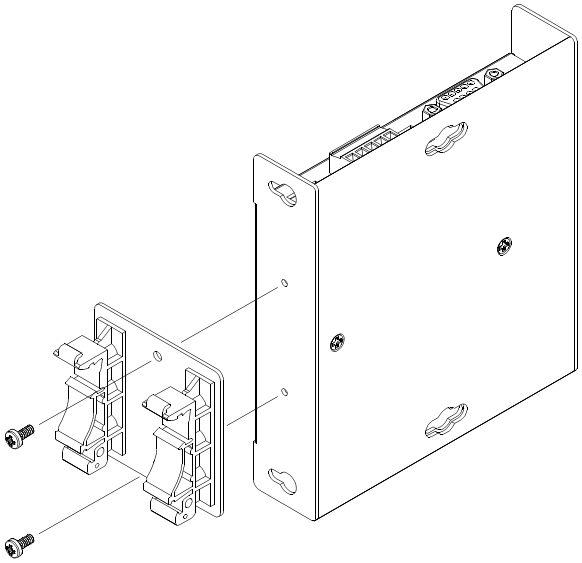
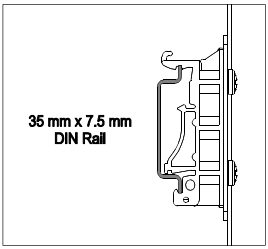
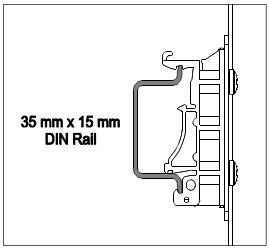
DIN Rail Mounting

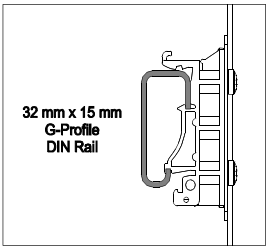
Fasten the optional DIN Rail Adapter (DA-01) to the BaudMaster™ with the mounting screws provided.



Mounts to standard DIN rail profiles: 35mm x 7.5mm Top-Hat Rail, 35mm x 15mm Top-Hat Rail and 32mm x 15mm G-Profile Rail.







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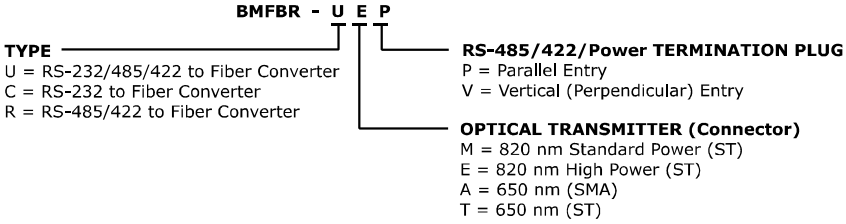
Ordering Information

The BaudMaster™ Fiber Converter is available in several different configurations. Choose the model that best fits your application needs. See website at www.interfaceconverter.com or call 800-248-1632 for current pricing or for combinations not shown in the table below.


BMFBR - U E P
TYPE
U = RS-232/485/422 to Fiber Converter
C = RS-232 to Fiber Converter
R = RS-485/422 to Fiber Converter
RS-485/422/Power TERMINATION PLUG
P = Parallel Entry
V = Vertical (Perpendicular) Entry
OPTICAL TRANSMITTER (Connector)
M = 820 nm Standard Power (ST)
E = 820 nm High Power (ST)
A = 650 nm (SMA)
T = 650 nm (ST)

Model	Wave-length	Optical Connector	Copper Interface	Max BPS	Max Range (ft) Copper/ Fiber	Temperature
BMFBR-UM(P/V)	820 nm	ST	RS-485/422/232	115200	4000/10000	-25°C to 80°C
BMFBR-CM(P/V)	820 nm	ST	RS-232	115200	50/10000	-25°C to 80°C
BMFBR-RM(P/V)	820 nm	ST	RS-485/422	115200	4000/10000	-25°C to 80°C
BMFBR-UE(P/V)	820 nm	ST	RS-485/422/232	115200	4000/15000	-25°C to 80°C
BMFBR-CE(P/V)	820 nm	ST	RS-232	115200	50/15000	-25°C to 80°C
BMFBR-RE(P/V)	820 nm	ST	RS-485/422	115200	4000/15000	-25°C to 80°C
BMFBR-UA(P/V)	650 nm	SMA	RS-485/422/232	115200	4000/650	-25°C to 80°C
BMFBR-CA(P/V)	650 nm	SMA	RS-232	115200	50/650	-25°C to 80°C
BMFBR-RA(P/V)	650 nm	SMA	RS-485/422	115200	4000/650	-25°C to 80°C
BMFBR-UT(P/V)	650 nm	ST	RS-485/422/232	115200	4000/650	-25°C to 80°C
BMFBR-CT(P/V)	650 nm	ST	RS-232	115200	50/650	-25°C to 80°C
BMFBR-RT(P/V)	650 nm	ST	RS-485/422	115200	4000/650	-25°C to 80°C

Accessories

Model	Description
DA-01	Din Rail Adapter (Includes adapter and hardware)
BM-PS120	Wall Plug Adapter, 120VAC @3W
BM-PS220	Wall Plug Adapter, 120VAC @3W
BM-PSU	Wall Plug Adapter, Universal 90-264VAC @3W
GC-9M	Gender Changer, 9 pin D sub Male/Male
CA-9F9M	Cable, DB9 Serial Male/Female (For RS-232)

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Cable

RS-422 and RS-485 communication requires twisted pair, low capacitance cable with a nominal impedance of 100-120 ohms. The decision to use shielded cable depends on the application.

RS-422 minimum cable requirements:
Shielded: Two twisted pair with drain wire (Use drain wire for signal ground)
Unshielded: Three twisted pair (Using extra pair for signal ground)

RS-485 minimum cable requirements:
Shielded: One twisted pair with drain wire (Use drain wire for signal ground)
Unshielded: Two twisted pair (Using extra pair for signal ground)

Belden Shielded RS-422 Cable

Part No.	Wire	D.C. Resistance	Outside Diameter	Impedance	Capacitance	Propagation Velocity
9829	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.291 In. 7.39 mm	100Ω	15.5 pF/ft 59.1 pF/m	66%
8102	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.270 In 6.96 mm	100Ω	12.5 pF/ft 41.0 pF/m	78%
8162	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.343 In 8.71 mm	100Ω	12.5 pF/ft 41.0 pF/m	78%
1419A	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.248 In 6.30 mm	100Ω	13.0 pF/ft 42.5 pF/m	78%
9729	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.317 In 8.05 mm	100Ω	12.5 pF.ft 41.0 pF/m	78%
9842	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.340 In 8.64 mm	120Ω	12.8 pF/ft 42.0 pF/m	66%
88102	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.227 In 5.77 mm	100Ω	12.95 pF/ft 42.0 pF/m	78%
89729	24 AWG (7x32)	23.3Ω/1000' 76.4Ω/km	.271 In 6.88 mm	100Ω	12.5 pF/ft 41.0 pF/m	78%

Belden Shielded RS-485 Cable

Part No.	Wire	D.C. Resistance	Outside Diameter	Impedance	Capacitance	Propagation Velocity
8132	28 AWG (7x32)	65Ω/1000' 213Ω/km	,235 In 5.97 mm	120Ω	11.0 pF/ft 36.1 pF/m	78%
9841	24 AWG (7x32)	24.0Ω/1000' 78.7Ω/km	.340 In 8.64 mm	120Ω	12.8 pF/ft 42.0 pF/m	66%

Category 3 (Cat-3) and Category 5 (Cat-5) cables are good choices for unshielded RS-485 and RS-422 cable.

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